


PATENT COOPERATION TREATY

Handwritten: P22629PCT

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

To: GORODISKEY & PARTNERS LIMITED Attn: Egorova, Galina B. Bolshaya Spasskaya Str. 7 Stranitsa 3 Moscow, 129610 FEDERATION DE RUSSIE	Date G&P: 05/02/2007  0003040855
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NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT AND
THE WRITTEN OPINION OF THE INTERNATIONAL
SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference 2420-300727 <i>Handwritten: R22/1041</i>	Date of mailing (day/month/year) 23/01/2007
International application No. PCT/RU2006/000152	International filing date (day/month/year) 30/03/2006
Applicant INTEL CORPORATION	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

Filing of amendments and statement under Article 19:
 The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally two months from the date of transmittal of the International Search Report.

Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes
 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.
☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**


Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site

Name and mailing address of the International Searching Authority  European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Ahmed Soliman
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NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the *PCT Applicant's Guide*, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report and the written opinion of the International Searching Authority, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only (see *PCT Applicant's Guide*, Volume I/A, Annexes B1 and B2).

The attention of the applicant is drawn to the fact that amendments to the claims under Article 19 are not allowed where the International Searching Authority has declared, under Article 17(2), that no international search report would be established (see *PCT Applicant's Guide*, Volume I/A, paragraph 296).

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the international Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 2420-300727	FOR FURTHER ACTION <small>see Form PCT/ISA/220 as well as, where applicable, item 5 below.</small>	
International application No. PCT/RU2006/000152	International filing date (day/month/year) 30/03/2006	(Earliest) Priority Date (day/month/year)
Applicant INTEL CORPORATION		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of:

- ☒ the international application in the language in which it was filed
☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box No. II)

3. ☐ **Unity of invention is lacking** (see Box No. III)

4. With regard to the **title**,

- ☒ the text is approved as submitted by the applicant
☐ the text has been established by this Authority to read as follows:

NO DOCKETING REQUIRED

N.A.

5. With regard to the **abstract**,

- ☒ the text is approved as submitted by the applicant
☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings**,

- a. the figure of the **drawings** to be published with the abstract is Figure No. 5
☐ as suggested by the applicant
☒ as selected by this Authority, because the applicant failed to suggest a figure
☐ as selected by this Authority, because this figure better characterizes the invention
- b. ☐ none of the figures is to be published with the abstract

INTERNATIONAL SEARCH REPORT

International application No

PCT/RU2006/000152

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F9/45

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 92/15941 A (DIGITAL EQUIPMENT CORP [US]) 17 September 1992 (1992-09-17) page 15, line 1 - page 18, line 12 page 28, line 13 - page 30, line 12 page 34, line 4 - line 14 page 39, line 8 - page 40, line 26 page 42, line 9 - page 47, line 5 page 48, line 11 - line 26 claims 1-17 figures 1-3	1-39
A	EP 1 329 806 A (XEROX CORP [US]) 23 July 2003 (2003-07-23) page 5, line 24 - page 8, line 49 ----- -/-	1-39

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"I" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"8" document member of the same patent family

Date of the actual completion of the international search

29 December 2006

Date of mailing of the international search report

23/01/2007

Name and mailing address of the ISA/

European Patent Office, P. B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Knapczyk, Frédéric

INTERNATIONAL SEARCH REPORT

International application No

PCT/RU2006/000152

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 247 174 B1 (SANTHANAM VATSA [US] ET AL) 12 June 2001 (2001-06-12) abstract column 3, line 6 - column 4, line 30 column 11, line 58 - column 12, line 16 column 14, line 10 - column 15, line 31 column 18, line 22 - column 19, line 28 claim 1	1-39
A	ANDERSSON N ET AL: "Overview and industrial application of code generator generators" JOURNAL OF SYSTEMS AND SOFTWARE, [Online] 31 March 1996 (1996-03-31), pages 185-214, XP002412956 Retrieved from the Internet: URL: http://www.sciencedirect.com/science?_ob=MImg&_imagekey=B6VON-3VSNKDY-C-2&_cdi=5651&_user=987766&_orig=search&_coverDate=03%2F31%2F1996&_qd=1&_sk=999679996&view=c&wchp=dGLbVtb-zSkWA&md5=bd778360d33e8375d418b307051f98d4&ie=/sdarticle.pdf [retrieved on 2006-12-28] abstract page 185, right-hand column, line 36 - page 189, right-hand column, line 10 page 190, left-hand column, line 9 - page 195, left-hand column, line 48 figures 1-4	1-39

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/RU2006/000152

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9215941	A	17-09-1992	
		AU 658399 B2	13-04-1995
		AU 1420492 A	06-10-1992
		AU 663310 B2	05-10-1995
		AU 1429292 A	06-10-1992
		AU 663311 B2	05-10-1995
		AU 1439792 A	06-10-1992
		AU 653799 B2	13-10-1994
		AU 1442292 A	06-10-1992
		AU 663493 B2	12-10-1995
		AU 1569892 A	06-10-1992
		CA 2081449 A1	28-08-1992
		CA 2081473 A1	28-08-1992
		CA 2081475 A1	28-08-1992
		CA 2081476 A1	28-08-1992
		CA 2081477 A1	28-08-1992
		DE 69225281 D1	04-06-1998
		DE 69225281 T2	07-01-1999
		EP 0528008 A1	24-02-1993
		EP 0526621 A1	10-02-1993
		EP 0526622 A1	10-02-1993
		EP 0529049 A1	03-03-1993
		EP 0532731 A1	24-03-1993
		JP 7069832 B	31-07-1995
		JP 6501579 T	17-02-1994
		JP 7069833 B	31-07-1995
		JP 6501580 T	17-02-1994
		JP 7069834 B	31-07-1995
		JP 6501581 T	17-02-1994
		JP 7062825 B	05-07-1995
		JP 6501582 T	17-02-1994
		JP 7062826 B	05-07-1995
		JP 6501583 T	17-02-1994
		WO 9215942 A1	17-09-1992
		WO 9215943 A1	17-09-1992
		WO 9215944 A1	17-09-1992
		WO 9215945 A1	17-09-1992
EP 1329806	A	23-07-2003	
		JP 2003223330 A	08-08-2003
		US 2003188297 A1	02-10-2003
US 6247174	B1	12-06-2001	NONE

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

PCT

see form PCT/ISA/220

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No
PCT/RU2006/000152

International filing date (day/month/year)
30.03.2006

Priority date (day/month/year)

International Patent Classification (IPC) or both national classification and IPC
INV. G06F9/45

Applicant
INTEL CORPORATION

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA.



European Patent Office - P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk - Pays Bas
Tel +31 70 340 - 2040 Tx: 31 651 epo nl
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Date of completion of
this opinion

see form
PCT/ISA/210

Authorized Officer

Knapczyk, Frédéric

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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/RU2006/000152

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:
 - ☒ the international application in the language in which it was filed
 - ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material:
 - ☐ a sequence listing
 - ☐ table(s) related to the sequence listing
 - b. format of material:
 - ☐ on paper
 - ☐ in electronic form
 - c. time of filing/furnishing:
 - ☐ contained in the international application as filed.
 - ☐ filed together with the international application in electronic form.
 - ☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/RU2006/000152

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-39
	No: Claims	
Inventive step (IS)	Yes: Claims	1-39
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-39
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

1. Reference is made to the following documents:

D1: DATABASE INSPEC [Online] THE INSTITUTION OF ELECTRICAL ENGINEERS, STEVENAGE, GB; March 1996 (1996-03), ANDERSSON N ET AL: "Overview and industrial application of code generator generators" XP002412956 Database accession no. 5215711

D2: US-B1-6 247 174 (SANTHANAM VATSA [US] ET AL) 12 June 2001 (2001-06-12)

D3: WO 92/15941 A (DIGITAL EQUIPMENT CORP [US]) 17 September 1992 (1992-09-17)

2. The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows (the references in parentheses applying to this document):

A code generation method (page 185, right-hand column, lines 37 to 39) comprising:

- having a table of pattern (collection of rules in figure 3) comprising a DAG representing multiply and add operations (figure 3, and page 186, left-hand column, lines 26 to 34),
- matching incoming expressions against the table of pattern during the compilation of a program (page 186, left-hand column, lines 26 to 34, page 188, right-hand column, lines 1 to 23 where the rules are the table of patterns).

The subject-matter of claim 1 differs from this known D1 in that the table of pattern is generated, it comprises an FMA DAG, a canonical form equivalent of the FMA DAG and a shape corresponding to the canonical form equivalent, and the floating-point expressions are matched against the patterns.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as how to decrease the time needed to perform an optimisation of floating-point expressions present in a source code.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

The document D1 deals with simple ADD instructions and never refers to the optimisation for the specific case of the FMA instructions; moreover, D1 stays silent about the *generation* of a table of patterns but refers to rules that are defined once and not when making a code generation. Even if the document D2 deals with the optimisation of source code containing FMA instructions (column 18, lines 22 to 40), it never mentions a pattern matching and pattern table generation to perform this optimisation but rather use inlining of low level instructions with type transformation. The document D3 describes a compiler using pattern matching to select a code template optimising the code (page 39, lines 8 to 25) and also uses an intermediate language representing the expressions using a DAG in order to analyse the operator-operand structure (page 48, lines 11 to 26) but does not refer to the generation of the pattern table. None of the documents refers to the use of a shape corresponding to the canonical form of the DAG.

3. The subject-matter of claim 17 is the same as the subject-matter of claim 1, written as an article and is inventive for the same reasons.
4. The document D3 is regarded as being the closest prior art to the subject-matter of claim 33, and shows (the references in parentheses applying to this document):
 - A code generation system comprising :
 - a processor
 - a memory comprising a code generator (page 7, lines 4 to 15 where a compiler is a code generator) having an optimiser and associated table of patterns (figure 1 and page 39, lines 8 to 25 where the matching with a pattern makes unambiguous the table of patterns).

The subject-matter of claim 33 differs from this known D3 in that the processor comprises fused instructions, the code generator comprises a floating-point module, receives a floating point expression and generates a sequence of optimal FMA, FMS or FNMA instructions to compute the expression.

The subject-matter of claim 33 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as how to reduce the computing time of a compiled floating point expression.

The solution to this problem proposed in claim 33 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: The document D1 to D3 fails to disclose such an optimisation of floating-point expressions. Even if the document D2 discloses the optimisation of floating-point expressions, it never finds an optimal set of fused instructions but rather introduces inlined low level instructions in the source code (column 3, lines 6 to 12).

5. Claims 2 to 16, 18 to 32 and 34 to 39 are dependent respectively on claims 1, 17 and 33 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

Bitte beachten Sie, dass angeführte Nichtpatentliteratur (wie z. B. wissenschaftliche oder technische Dokumente) je nach geltendem Recht dem Urheberrechtsschutz und/oder anderen Schutzarten für schriftliche Werke unterliegen könnte. Die Vervielfältigung urheberrechtlich geschützter Texte, ihre Verwendung in anderen elektronischen oder gedruckten Publikationen und ihre Weitergabe an Dritte ist ohne ausdrückliche Zustimmung des Rechtsinhabers nicht gestattet.

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